Appendix C – Black Hills Project Dead Wood Analysis

DecAID can help managers decide how much snag and down wood of different sizes should be retained to meet wildlife management objectives for a particular project or area (Mellen et al, 2006). The information contained in DecAID is based on published scientific literature, research data, expert judgment, and professional experience. It is primarily a statistical summary of published research data for wildlife presence (mainly cavity-nesting birds) and inventoried forest conditions (Mellen et al, 2006). DecAID presents information on the range of "natural conditions" (as represented by unharvested plots within the plots sampled) "current conditions" (all plots sampled, including both unharvested and harvested plots) and wildlife use, with respect to:

- Densities (abundance) of snags and down wood
- Sizes of snags and down wood

Definition of "wildlife data", as used in DecAID:

"Wildlife data" as used in DecAID refers to the data collected in a variety of wildlife studies conducted in specific vegetation types found in the West. Most of the data was collected for bird species, primarily cavity-nesters such as woodpeckers. The **wildlife data** in DecAID is provided in the form of tolerance levels of 30 percent, 50 percent, or 80 percent. In other words, for a given study location, data was collected that correlated certain stand conditions (size and abundance of snags and down wood) with nesting use by 30 percent, 50 percent or 80 percent of the population of a particular species in that area.

Referring to the array of wildlife data collected (not just that for post-wildfire habitats) DecAID notes:

> "The wildlife studies, on which the wildlife portion of DecAID is based, were conducted in a variety of landscapes and site conditions. Typically, the studies (a) did not report how the general study areas and specific study sites were chosen relative to others, and (b) did not describe how the vegetation conditions within the general study areas and specific study sites differed from conditions within a broader area, especially within the wildlife habitat and vegetation condition classes used in DecAID. Due to this unknown bias, it is recommended that the user of DecAID drill down to the underlying data and evaluate if the studies are applicable to their particular situation and/or if the number and breadth of the studies adequately capture the range of conditions within the wildlife habitat (Mellen et al. 2006).

Definition of "tolerance level", as used in DecAID <u>for wildlife data</u>:

"Tolerance level" associated with snag densities at nest sites is the percent of individual birds within a given population that would be expected to nest in forest stands characterized by a certain number and size range of snags. Tolerance level can be interpreted as levels of probability that stands characterized by a given range of numbers and sizes of snags will be used for nesting by an increasing percentage of a particular bird population as tolerance level increases.

Blackhills Vegetation Distribution Information

Table 1. Vegetation types on Forest Service land within the Blackhills project area by acres (rounded to the nearest 100 acres) and percent of project area.

Vegetation Type	Approximate Acres	Approximate Percentage of the Subsheds
Juniper / Other Non-Forested	4,300	15
Pine Associated	8,300	29
Ponderosa Pine	14,700	50
Lodgepole Pine	1,700	6
Total	29,000	100

The Silviculturist on the interdisciplinary team determined the percentages of the forested areas in the watershed as displayed in Table 1 above. The Sivliculturist also determined vegetation seral stages for both reference and current conditions in Table 2 below from historical data and current conditions. The juniper vegetation type will not be addressed related to snags or down wood.

There currently appears to be a shortage of the early seral stage. The current late and old seral stands are dominated by multi storied stands instead of single story stands as occurred historically (Table 2).

Table 2. Current and reference vegetation seral stages as applied to the Black Hills project area.

Seral Stage	**Reference Condition % of Forested Acres**	**Current Condition % of Forested Acres**
Early Seral	10-30	7
Mid Seral	20-40	31
Late and Old Seral	40-70	62

1/ In reference data, Late and old seral stages are combined.

A more recent analysis is obtained from work done for an Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins (Quigley and Arbelbide Tech. eds., 1997).

Table 3 below compares the physiognomic type of forested acres on National Forest System Lands to historical estimates. The comparison is for the dry forest potential vegetation group (PVG) for the Upper Klamath Ecological Reporting Group (ERG).

Table 3. Historical and Current Physiognomic types (ICBEMP) within the National Forest in the Black Hills planning area.

Physiognomic Type	Historical	Blackhills Planning Area
Early-Seral Forest	6-10%	7%
Mid-Seral Forest	14-35%	31%
Late-Seral Multilayer forest	12-15%	60%
Late-Seral Single Layer forest	53-80%	2%

Comparing the data in these tables, the area is within the HRV in all stages for reference conditions shown in Table-1. Table-2 shows that there has been a distinct shift away from late succession single story stands. This stand structure is well below HRV. Conversely, late succession multilayer forest is well above HRV.

1. Snags

Existing Snag Information

Due to the type of project and the resource protection measure related to felling of snags, snag data was not collected for this proposed project. A qualitative assessment was completed while working in the area. It was noted that snag densities appeared to range from 0 to > 20 snags per acre within the project area, and that it appeared we were meeting Forest Plan Standards for snag densities when considered at the watershed scale.

GNN Data

Table 5 below displays snag information contained in the Gradient Nearest Neighbor data set. GNN contains data averaged over many stand types and conditions. The larger the scale that this data is used, the more accurate it becomes for particular vegetation types. This data indicates that we exceed Forest Plan standards related to snag densities. The lodgepole data is not displayed due to rapidly changing conditions on the ground. Insects are killing lodgepole and some large ponderosa pine at a fast enough rate that GNN historical data would not give a true picture or be useful.

Table 5. GNN snag data for the eastside of the Fremont-Winema National Forest by major vegetation type

Number of Snags	Mixed Conifer Snags per Acre	Ponderosa Pine Snags per Acre
≥ 12 cm (4.7 in.) DBH	**18.3**	**10.6**
≥ 25 cm (9.8 in.) DBH	**6.6**	**4.5**
≥ 50 cm (19.7 in.) DBH	**1.5**	**0.6**

How Information in DecAID (version 2.0) was Considered in this Dead Wood Analysis

For this project, DecAID was not used to determine appropriate snag levels across the project area. Because this project will have a minimal affect on snag habitat (snags will only be felled if they pose a safety hazard during logging operations, which are primarily along roads and landing areas), there was not a need to determine snag numbers. DecAID was not used to determine species viability. Individual species effects are discussed under effects for those species that may be effected. DecAID was used to identify what tolerance levels should be being provided for within the project area.

DecAID Snag Diameter Information

Table 6 below displays the average snag diameter used by cavity excavator species by tolerance level and forest habitat type taken from DecAID. Table 7 below shows the relationship between snag diameter and tolerance levels for selected wildlife species. Generally speaking higher tolerance levels provide for a greater percentage of the individuals within a population.

Table 6. Snag diameter information by tolerance levels for selected wildlife species from DecAID Tables EMC_L.sp-17, EMC_S.sp-17, PPDF_S/L.sp-17.

Forest Wildlife Habitat Type	**Mixed Conifer**			**Ponderosa Pine/ Douglas Fir**		
Species	**30% t.l. snag DBH (in)**	**50% t.l. snag DBH (in)**	**80% t.l. snag DBH (in)**	**30% t.l. snag DBH (in)**	**50% t.l. snag DBH (in)**	**80% t.l. snag DBH (in)**
BBWP-Black-backed Woodpecker	8.8	12.0	16.7	8.1	13.2	20.5
HAWO-Hairy Woodpecker	10.5	16.3	25.2	10.3	16.4	25.3
NOFL-Northern Flicker	17.7	22.2	30.6	17.2	21.8	28.8
PCE-Primary Cavity Excavators	16.8	23.1	33.3	no data	no data	no data
PIWO-Pileated Woodpecker	25.2	29.5	36.0	25.5	30.1	36.8
WHWO-White-headed Woodpecker	20.8	26.7	35.9	20.8	26.7	35.9
WISA-Williamson's Sapsucker	20.2	26.2	34.6	20.0	25.8	34.5
Data Source within DecAID	Table EMC_L.sp-17 and EMC_S.sp-17. (numbers in these tables are the same)			Table PPDF_S/L.sp-17		

When Table 6 above is compared with Tables 3, 4, and 5 above, it shows that the project area is providing snag diameters that could be used by these wildlife species. Generally speaking higher tolerance levels provide for a greater percentage of the individuals within a population.

Snag Density Information

Densities of snags are also important for determining level of habitat provided. Table 8 below was compiled from information from DecAID (version 2.0) Tables EMC_S/L.sp-22 and Table PPDF_S/L.sp-22. These tables contain synthesized data for wildlife use of snag densities from various studies for the Eastside Mixed Forest Conifer or Ponderosa Pine/Douglas-fir Forest Wildlife Habitat Types and Small/medium Trees and Larger Trees Structural Condition Classes. Except where noted the information was the same in both tables, or existed in only one table.

Interpreting Table 7 below indicates for the four cavity excavator species with data available generally shows that increasing the snag diameter reduces the number of snags per acre needed to accommodate the same percentage of the population

Table 7. Synthesized snag density information by tolerance levels for selected wildlife species from DecAID Tables EMC_S/L.sp-22 and, PPDF_S/L.sp-22.

	Snag Size >= 6.4" dbh			**Snag Size >= 9.6" dbh**			**Snag Size >= 20" dbh**		
Species	**30% t.l. snag density (#/ac.)**	**50% t.l. snag density (#/ac.)**	**80% t.l. snag density (#/ac.)**	**30% t.l. snag density (#/ac.)**	**50% t.l. snag density (#/ac.)**	**80% t.l. snag density (#/ac.)**	**30% t.l. snag density (#/ac.)**	**50% t.l. snag density (#/ac.)**	**80% t.l. snag density (#/ac.)**
BBWP-Black-backed Woodpecker	no data	no data	no data	2.5	13.6	29.2	0	1.4	5.7
PIWO-Pileated Woodpecker	no data	no data	no data	14.9	30.1	49.3	3.5	7.8	18.4
WHWO-White-headed Woodpecker Table EMC_S/L.sp-22 only	0.8	3.0	6.2	0.3	1.9	4.3	0	1.5	3.8
WHWO-White-headed Woodpecker Table PPDF_S/L.sp-22 only	1.1	4.0	8.2	0.3	1.7	3.7	0.5	1.8	3.8
WISA-Williamson's Sapsucker	no data	no data	no data	14.0	28.4	49.7	3.3	8.6	16.6

In summary, snag densities were compared with Tables 3, 4, and 5. The following species are currently being provided for at the tolerance levels indicated. Pockets are areas where there are patches of bug kill, but these are not well distributed across the project area; however, they still provide habitat. Also, the entire project area is not expected to be providing snag habitat, but where small/medium and larger tree stands are present these stands would be expected to contribute snags within the project area.

Table 8. Comparison of available snag data to tolerance intervals for wildlife from DecAID Tables EMC_S/L.sp-22 and PPDF_S/L. sp-22. "A" is stand average and "P" is pockets of snags from Table 6 and personal observations.

	Snag Density > 9.6" dbh				Snag Density > 20" dbh			
Species	**0-30%**	**30-50%**	**50-80%**	**>80%**	**0-30%**	**30-50%**	**50-80%**	**>80%**
BBWP-Black-backed Woodpecker	A			P			A	
PIWO-Pileated Woodpecker	P				P			
WHWO-White-headed Woodpecker Table EMC_S/L.sp-22 only				A, P			A	
WHWO-White-headed Woodpecker Table PPDF_S/L.sp-22 only				A, P	A			
WISA-Williamson's Sapsucker	P				P			

The high numbers of snags per acre for the pileated woodpecker especially at the 30 percent tolerance level was data collected within nest sites. Attaining snag densities at this level within the project area is only possible in the moist mixed conifer sites. The PIWO data were collected primarily at EMC sites (Nielsen-Pincus 2005). Table 5 included data from Ponderosa pine and mixed conifer stands. The wildlife data is from studies of nest stands, and densities above corresponding tolerance levels for inventory data and above maximum snag densities measured on inventory plots in PPDF (EMC_ECB_S.inv-2 and PPDF_S.inv-2) indicating selection of high density clumps of snags for nest sites.

DecAID Historical Information

Harrod et al. (1998) estimated historical snags densities in ponderosa pine-dominated, dry forests. Harrod estimated that densities of snags greater than 6 inches dbh ranged from 5.9 to 14.1/acre in pre-European settlement landscapes. Their estimates were derived by calculating growth in basal area from pre-1930 growth rates, holding forest stand structure relatively constant (i.e. as a new live tree is recruited another one becomes a mortality), and applying published snag fall rates (Bull 1983, Keen 1929, Raphael and Morrison 1987, Schmid et al. 1985) to calculate basal area of snags every 10 years. They assumed that historic frequent, low-intensity fires did not accelerate snag fall rates.

Agee (2002) estimated lower snag densities than Harrod et al. for the ponderosa pine/Douglas-fir forest series by estimating number of trees in 0.1ha clumps of 16 age classes and assuming that the oldest patch is killed by insects every 25 years. He assumed fire helped to decompose snag patches and that after 5 fires at 10-year intervals the snags would be completely consumed. His estimated historical snag density was 2 per acre. Agee (2002) compares his estimates to Harrod et al. (1998) but states a different assumption about dbh of snags; Agee assumes an average snag dbh of 75 cm (30 in) when calculating biomass, while Harrod et al. estimated densities for size classes as small as 15 cm (6 in) dbh. Results from regional studies in Eastern Washington and Oregon (of all ownerships) by Ohmann and Wadell suggest there are currently 2.025 total snags per acre greater than 10 inches dbh of which 0.405 snags were greater than 20 inches dbh (2002).

There is a ponderosa pine site in Idaho that has never been harvested and that has undergone wildfires over the past decades. Recent snag data from this site reveals that there are approximately 3.6 snags per acre > 12" dbh.

GNN data and FID flight data would indicate that on average the project area exceeds these snag densities. However, there are areas where snags are likely scarce. These areas are past clear cuts and areas alongside roads.

Snag Summary for the Proposed Project Area

Harvest prescriptions within the proposed project area call for variable density spacing. The affect of this on these stands is that there will be a mosaic of stand densities across the landscape, and these stands would be within the historical range of variability, and therefore, should continue to allow the natural processes that create snags to function. Also, the design criteria to retain 5-15% of each treatment unit untreated will still leave areas of these stands above the insect threshold. These are designed to provide diversity across the landscape. It is expected that habitat for snag and down wood dependent species would continue to be provided across the landscape as a result of leaving stands fully stocked, using variable density thinning with untreated skips and moving stand conditions closer toward those that historically occured.

Within the ponderosa pine vegetation there has been a shift from the larger tree structural stage to both open and small/medium structural stages. This shift resulted from past harvest practices, and fire suppression. In areas of past clear cuts, snag density is likely less than what would have occurred historically.

The overall affect is that without recent snag survey data, it is difficult to quantify statistically what is there right now. However, it appears that based on the snag information available that the area is likely meeting Forest Plan standards (white paper from the Forest identifying 4 snags/acre), and is also likely within or above the Historical Range of Variation.

2. Down Wood

Definition of "down wood percent cover", as used in DecAID:

DecAID includes data on down wood, a habitat component used by many wildlife species. DecAID uses "down wood percent cover" to measure the presence of down wood on a given acre. "Down wood percent cover" means within a given area, the percentage of the ground that is covered with down wood at least 4.9 inches dbh on the small end and at least 3.3 feet long. Wood in any decay class is included in the measurement as long as it meets the size criteria.

This way of measuring down wood was used in DecAID because it best describes the abundance of down wood as it relates to wildlife use (Carey 1995). "Down wood percent cover" is one of the most precise and efficient means of recording amounts of down wood, and is the measure most commonly used in research studies that investigate wildlife use of down wood. As an illustration of how this measure is applied, one acre exhibiting 0.9 percent down wood cover might contain:

- One 30-inch dbh ponderosa pine down tree 100-feet long
- One 20-inch dbh ponderosa pine down tree 80-feet long

- One 15-inch dbh ponderosa pine down trees 60-feet long
- Two 10-inch dbh ponderosa pine down trees 40-feet long

or, that same acre could also exhibit 0.9 percent down wood cover with one of the groups below:

- 4.0 - 20-inch dbh ponderosa pine down trees 80-feet long **OR**
- 6.7 - 15-inch dbh ponderosa pine down trees 60-feet long **OR**
- 16.7 - 10-inch dbh ponderosa pine down trees 40-feet long.

DecAID provides information on American marten, the woodpeckers as a group and ants upon which several species forage. The following table is information combined from DecAID Tables EMC_L.sp-21, PPDF_S/L.sp-21. These tables are the results of synthesized data for wildlife use of down wood sizes (diameter) for denning, resting, ant colonies, foraging and occupied sites from studies for the various habitat types.

Table 9. Synthesized Data For Wildlife Use of Down Wood Sizes From Various Studies By Forest Type, Small and Large Structure Size and Tolerance Level From DecAID.

Habitat Type	**Mixed Conifer**			**Ponderosa Pine**		
Species	30% t.l. Down Wood Dia. (in)	50% t.l. Down Wood Dia. (in)	80% t.l. Down Wood Dia. (in)	30% t.l. Down Wood Dia. (in)	50% t.l. Down Wood Dia. (in)	80% t.l. Down Wood Dia. (in)
AMMA-American Marten	20.7	26.1	33.2	no data	no data	no data
LANT-Large ant species	7.4	10.3	14.8	6.9	9.6	13.6
SANT-Small ant species	7.5	10.3	14.6	7.7	10.2	13.9
WOPE-Wood peckers	8.0	11.2	16.0	7.8	10.1	13.9

The last piece of information needed to evaluate the habitat is the density of down wood. Again DecAID is used to describe habitat needs of species for which information is available. Table 10 information below is from DecAID table EMC_S/L.sp-24. Information on the ponderosa pine type was not available.

Table 10. Synthesized Data For Wildlife Use of Down Wood Densities From Various Studies By Forest Type, Small and Large Structure Size and Tolerance Level From DecAID.

Habitat Type	**Mixed Conifer (> 5.9" Dia.)**			**Ponderosa Pine/ Douglas Fir**
Species	30 %t.l. Down Wood Cover (%)	30 %t.l. Down Wood Cover (%)	30 %t.l. Down Wood Cover (%)	No Data in DecAID
BBWO-Black-backed woodpecker	4.7	13.0	25.1	
PIPO-Pileated woodpecker	4.0	4.5	5.1	

Due to a lack of quantifiable data, it is not known how much down wood is present within the proposed project area, and therefore, unknown what tolerance levels are being provided for. Areas of past clear cuts are likely not providing much down wood; however, due to fire exclusion and limited prescribed burning, much of the area should be providing down wood levels towards the upper end or above what has occurred historically.

Down Wood Summary for the Proposed Project Area

While data was not available for down wood percent cover and wildlife use, other projects on this Forest have looked at the vegetation inventory information for down wood percent cover, and at least in the ponderosa pine it appears to be on the high side of what would have been on the ground historically with a frequent fire return interval. However, anecdotal reports from another Forest that had similar concerns found that they had down wood densities that were within the range of inventory data from DecAID. These reports are from another Forest that has similar vegetation conditions, moisture regimes, and fire histories. Also historically, it is likely that the higher density areas of down wood were part of the shifting mosaic across the landscape that resulted from insects or fire killing small patches of trees.

The felling of hazard trees would help retain down wood if they are not removed, some are expected to be left. However, by re-introducing fire into these stands, some of this would be consumed. As prescribed fire use is continued over time, the area would be expected to provide down wood consistent with HRV levels, and also at levels consistent with what the stand is capable of providing.

Continuation of Ecological Processes

The Silviculturist identified that many of the open stands are mainly past clear cuts, a technique which the Forest does not currently practice. Past clear cuts are moving towards the small/medium structural stage, and should be there in 10-20 years.

The Blackhills project is retaining existing snags (except hazard trees), and future snags are being provided for by retention of stocked stands, 5-15% retention areas, and not treating all of the area within the project boundary.

The Blackhills project is retaining existing down wood, and future down wood is being provided for by retention of existing snags, and maintaining tree stocking levels within or at the high end of the historical range of variability.

It is assumed that if snag numbers and distribution and down wood size and distribution are similar to "natural" conditions, that we would be meeting the snag needs of cavity nesting birds

under the historic range of variability. Areas of past management activities (past harvest) are likely deficient in snags. Therefore, stands that are currently stocked with commercial size trees would likely be needed to meet snag dependant species requirements across the subsheds. This is consistent with the proposed projects requirements to retain existing snags except where they pose a safety issue.